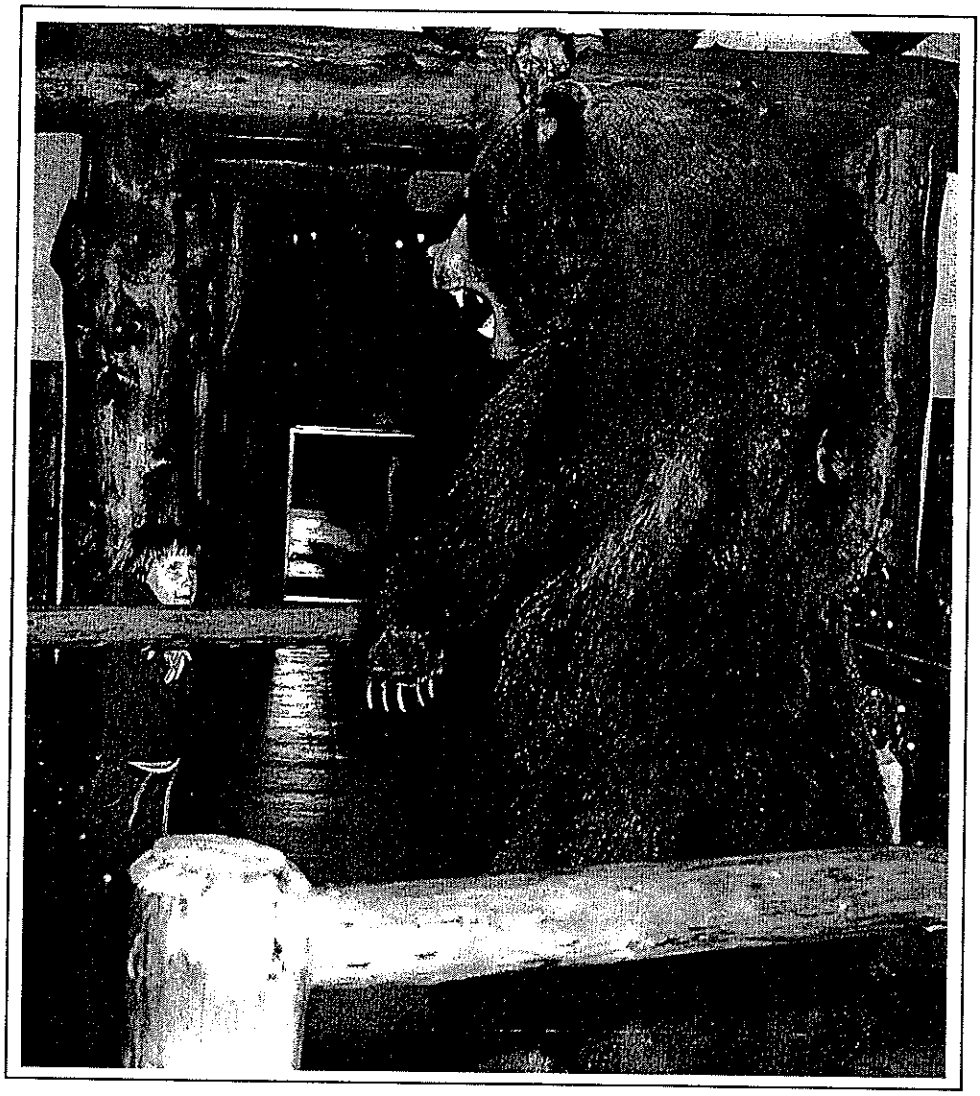
Yellowstone Science

A quarterly publication devoted to the natural and cultural sciences



The Why's and Where's of Bear Attacks
Common Knowledge on the Range
A Yellowstone Millipede

Volume 4 Number 1

NPS Photo

New Wolves

This page usually gets written last, as we are hurrying to get *Yellowstone Science* to the printer. That means, among other things, that after we have the "News and Notes" all done, we still have this one last chance to tell you something that we didn't have time to tell you in the back of the magazine.

This winter, two federal shutdowns and continuing uncertainties about which parts of the park operation would be funded forced us to wait a little longer before completing this issue of *Yellowstone Science*. But at the same time, the wolves kept making news, so it was hard to know when to stop adding new stories about them and call the news finished.

The latest big news is that the new wolves have arrived. On Tuesday, January 23, the year's first eleven were delivered to acclimation pens at Blacktail Plateau (one male, one female), Crystal Creek (two males, two females), and Nez Perce Creek (two males, three females). On January 27, one more female was added to Nez Perce (part of the same pack, but captured later), and five more (one male, four females)were placed in the Rose Creek pen for a total of 17 new wolves. All four pens have potential breeding pairs. The largest wolf is the 130-pound alpha male at Nez Perce, who is larger than any of last year's wolves.

Public and media attention to this year's arrivals was not as extensive as last year, but a busload of media and park staff were on hand to snowshoe half a mile in to watch the placement of the young pair at the new Blacktail pen. Unlike last year's wolves, who were generally quite cautious about leaving their shipping containers, these two rushed from the containers as soon as they were opened. In the photograph above, Wolf Biologist Doug Smith (left) and Assistant Superintendent Marv Jensen are releasing the first of these two.

There is more wolf news to be reported, but we must save it for the next issue. In the meantime, we can report that the Yellowstone area now has a total of 38 wolves, with high hopes of more come spring.

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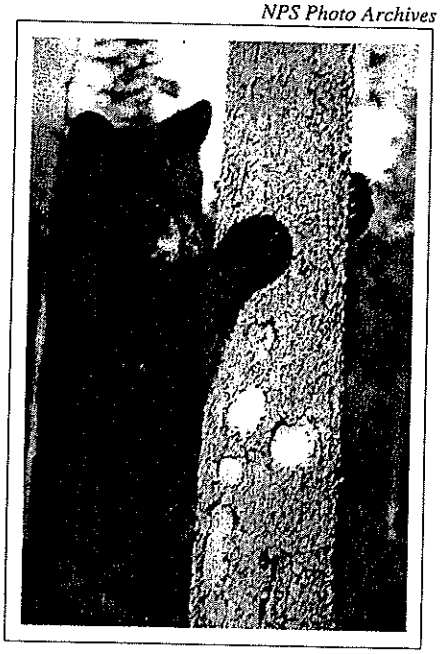
Volume 4 Number 1 Winter 1996

NPS Photo Archives



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On the cover: Bears have fascinated, entertained, and frightened Yellowstone visitors for more than a century. The face of this young visitor, at the Fishing Bridge Visitor Center in the 1960s, captures much of our wonder at the park's most famous and dangerous animals. See the article on page 2.

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Yellowstone Science is published quarterly, and submissions are welcome from all investigators conducting formal research in the Yellowstone area. Editorial correspondence should be sent to the Editor, *Yellowstone Science*, Yellowstone Center for Resources, P.O. Box 168, Yellowstone National Park, WY 82190.

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Bear-Inflicted Human Injuries in Yellowstone, 1970-1994

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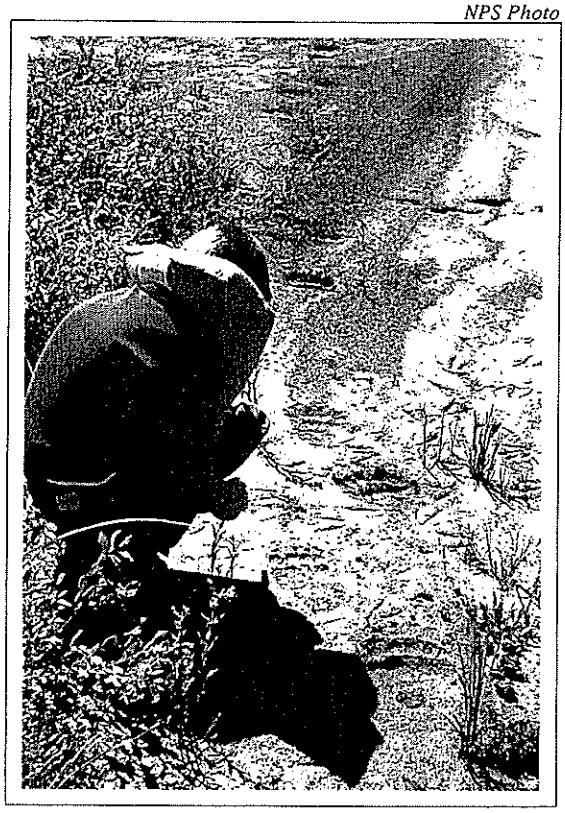


A cautionary and instructive guide to who gets hurt and why

by Kerry Gunther and Hopi Hoekstra

Yellowstone's bears have been an important tourist attraction for many years, but both the bears and the tourists have suffered because of this familiarity. From 1930 through 1969, an average of 45 people per year were injured by black bears in the park. During the same time period, grizzly bears injured an average of 2 people per year. Most of these injuries occurred along roadsides or in developed areas and involved human foods or garbage as bear attractants.

Due to concerns for human safety and potential loss of free-ranging wild bears, bear management policy within Yellowstone National Park (YNP) has been progressively intensified over time, especially since 1970, the year the last park dump was closed. These improvements in management actions, along with public education, may be responsible for the decline in bear-inflicted human injuries from 1970 through 1994, despite the continuing increase in park visitation (Table 1). This paper reviews bear injuries during the past 25 years, and shows what activities and types of behavior by people are most likely to result in human injuries.

To compile this report, we reviewed 25 years of YNP files, including case incident reports, personal statements, and newspaper articles. We included only injuries that were verified by park personnel; all dubious cases were excluded. Information obtained from the files included date, approximate time, and location (developed area, roadside, or backcountry) of bear-caused human injury. Developed area injuries are defined as those that occurred in or adjacent to human developments. Roadside injuries included all incidents that occurred within or immediately adjacent to the road corridor. Backcountry is defined as all areas excluding roadsides and developed areas. Further information collected included the number of people in the party, gender of the injured person, activity of the party prior to injury, reaction of the person to the attacking bear, species of bear involved, and sex and age class of bear, if known. The extent of the injury, whether minor (requiring less than a day of hospitalization or less than 35 sutures) or severe (requiring more than one day of hospitalization or 35 or more sutures) was also recorded.

How Many Injuries, and Where?

The total number of YNP visitors steadily increased since 1970 and reached

NPS Photo

Grizzly bear sows with young of the year were statistically the most likely to be involved in backcountry bear attacks.

Table 1. Number of park visitors, number of bear-inflicted human injuries, and number of injuries per million visitors in Yellowstone National Park, 1970-1994.

Year	Number of visitors	Number of injuries	Injuries per million visitors
1970	2,297,290	12	5.2
1971	2,120,487	9	4.3
1972	2,246,827	8	3.6
1973	2,061,537	6	2.9
1974	1,937,768	7	3.6
1975	2,246,132	3	1.3
1976	2,525,174	8	3.2
1977	2,487,084	3	1.2
1978	2,623,141	2	0.8
1979	1,891,927	3	1.6
1980	2,009,581	1	0.5
1981	2,544,242	4	1.6
1982	2,404,862	0	0.0
1983	2,405,653	2	0.8
1984	2,262,969	5	2.2
1985	2,262,455	0	0.0
1986	2,405,063	3	1.3
1987	2,618,249	0	0.0
1988	2,219,128	0	0.0
1989	2,680,376	1	0.4
1990	2,857,096	0	0.0
1991	2,957,856	0	0.0
1992	3,186,190	1	0.3
1993	2,912,193	0	0.0
1994	3,046,645	4	1.3

an all time high of more than 3 million visitors per year in 1992. Backcountry use nights increased through the 1970s, dropped during the early 1980s, and increased again in the early to mid-1990s. During the same period, however, total bear-inflicted human injuries have steadily decreased, while the bear-inflicted injury rate in the backcountry remained relatively constant.

In the 25-year period 1970-1994, 82 people were injured in 77 separate incidents in YNP (Table 2). Of these injuries, 60 (73%) were considered minor, 19 (23%) were severe, and 3 (4%) resulted in fatalities. Black bears and grizzly bears were involved in 32 (39%) and 42 (51%) of the injuries, respectively. The species of bear involved could not be determined for 8 (10%) of the injuries. Only one person was injured in most (94%) bear attacks, but in each of 5 (6%) cases 2 persons were injured. There were no incidents reported in which more than 2 people were injured. In 4 of the 5 (80%) incidents in which more than 1 person was injured, female bears with cubs-of-the-year (COY) were involved. Overall, female bears with young (COY or yearlings) were involved in 29 (35%) of the injuries. Fifty-nine (72%) of the people injured were male and 22 (27%) were female; 1 (1%) report did not list the gender of the injured person. All injuries occurred from May through November; most injuries occurred during August (37%). Injuries occurred in developed areas (13%), along roadsides (43%), in backcountry areas (41%), and during research or management handling of bears (2%).

The trend in the location of bear-inflicted injuries has changed dramatically from 1970-1994. Whereas roadside injuries predominated (56%) during the period 1970-1979, there were no roadside injuries reported from 1980-1994. From 1980 through 1994, most (80%) bear-inflicted injuries occurred in the backcountry.

There was also a change over time in the species of bear involved in human injuries. During the period from 1970 through 1979, when most injuries occurred along roadsides, 40 (66%) of all bear-inflicted human injuries were reportedly caused by black bears, 15 (24%) by grizzly bears, and 6 (10%) by unidentified species. From 1980 through 1994, when most injuries occurred in the backcountry, 17 (81%) of all bear-inflicted human injuries were caused by grizzly bears, 2 (10%) by black bears, and 2 (10%) by unidentified bear species. Whereas black bear-caused injuries de-

Table 2. Number of visitors, backcountry use nights (BUN), and bear-inflicted human injuries by grizzly bears, black bears, and unknown species of bears in Yellowstone National Park, 1970-1994.

			Bear-inflicted human injuries														
			Total			Developed area			Roadside			Backcountry			Handling		
Year	Visitation	BUN	Gr	Bl	Un	Gr	Bl	Un	Gr	Bl	Un	Gr	Bl	Un	Gr	Bl	Un
1970	2,297,290		4	6	2	2	1	1	0	5	1	0	0	0	0	0	0
1971	2,120,487		0	9	0	0	0	0	0	9	0	0	0	0	0	0	0
1972	2,246,827		2	5	1	0	0	1	0	5	0	2	0	0	0	0	0
1973	2,061,537	36,219	0	5	1	0	0	1	0	3	0	0	2	0	0	0	0
1974	1,937,768	41,282	0	7	0	0	0	0	0	7	0	0	0	0	0	0	0
1975	2,246,132	44,374	2	1	0	0	0	0	0	1	0	2	0	0	0	0	0
1976	2,525,174	50,580	4	4	0	2	0	0	0	4	0	2	0	0	0	0	0
1977	2,487,084	55,331	1	2	0	0	1	0	0	0	0	1	1	0	0	0	0
1978	2,623,141	52,795	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0
1979	1,891,927	51,182	2	0	1	0	0	0	0	0	0	2	0	1	0	1	0
1980	2,009,581	54,874	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
1981	2,544,242	55,060	2	1	1	0	1	0	0	0	0	1	0	1	1	0	0
1982	2,404,862	49,400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	2,405,653	43,738	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0
1984	2,262,969	34,936	5	0	0	1	0	0	0	0	0	4	0	0	0	0	0
1985	2,262,455	32,532	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	2,405,063	31,414	2	0	1	0	0	0	0	0	0	2	0	1	0	0	0
1987	2,618,249	32,906	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	2,219,128	25,188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	2,680,376	32,747	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
1990	2,857,096	37,318	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	2,957,856	41,476	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	3,186,190	42,124	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
1993	2,912,193	45,135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	3,046,645	45,460	4	0	0	0	0	0	0	0	0	4	0	0	0	0	0

creased dramatically with the decrease in roadside panhandling by black bears, injuries inflicted by grizzly bears in backcountry areas remained relatively constant over time.

Injuries in Developed Areas

From 1970 through 1994, 11 bear-caused injuries occurred in developed areas in YNP; 9 (82%) of these injuries occurred prior to 1979. Only 2 (18%) of the injuries in developed areas occurred during the last 16 (1979-1994) years. All injuries in developed areas occurred in (91%) or near (9%) roadside campgrounds: 4 at Grant Village, 3 at Fishing Bridge, 2 at Canyon, and 1 each at Bridge Bay and Madison. Grizzly bears and black bears were involved in 5 (46%) and 3 (27%) of the injuries, respectively. The species of bear involved could not be determined for 3 (27%) of the injuries. Injuries in developed areas occurred during July (27%), August (55%), and September (18%). All injuries caused by grizzly bears in developed areas occurred between 1:00 and 4:00 a.m. All injuries caused by black bears in developed areas occurred between 5:30 a.m. and 2:30 p.m. Female grizzly bears with COY were involved in 36% (4) of the injuries and single adult bears (1 grizzly bear, 1 black bear) in 18% (2). The age class of the bear involved could not be determined for 46% (5) of the injuries. Fifty-five percent of the injuries (4 by grizzly bear, 2 by black bear) were considered severe and 45% (1 by a grizzly bear, 1 by a black bear, and 3 by unknown species) were minor. Only one person was injured in most (90%) attacks that occurred in de-

NPS Photos

Overnight camping in Yellowstone's backcountry demands careful attention to sanitation. Visitors staying in park campgrounds should be extremely careful with food storage. Not only should they follow all regulations, but also they should feel free to be a little nosy and make sure their neighbors are doing the same.

veloped areas. The only incident in which more than one person was injured involved an adult female grizzly bear with a cub that injured 2 people.

Of the 11 people injured by bears in developed areas, 4 (45%) were involved in improper behavior: 4 (3 by grizzly bears, 1 by unknown species) involved improper food storage and 1 (by a black bear) occurred in an illegal camp. Of these 5 injuries, 2 involved people who were sleeping outside "under the stars" in sleeping bags next to improperly stored food, 1 involved a person who had left food stored next to his tent at night, 1 injury resulted from a man leaving his trailer to attempt to chase a female grizzly bear with cubs away from an improperly stored cooler at night, and one incident involved a person who was sleeping outside in a sleeping bag in an illegal camp.

Six attacks were considered unprovoked: 2 (1 by a grizzly bear, and 1 by a black bear) involved people sleeping in tents, 2 (1 by a grizzly bear, 1 by an unknown species) involved people sleeping outside "under the stars" in sleeping bags, 1 incident (by an unknown species) involved a person walking through a developed area, and 1 incident involved a black bear attempting to carry off an infant that was sleeping outside in a playpen. Ten (91%) of the people injured in developed areas were male (4 by grizzly bears, 3 by black bears, 3 by unknown species). Only 1 (9%) of the injured people was female (by a grizzly bear).

Injuries Along Roadsides

From 1970 through 1994, there were 35 people injured in 34 separate incidents along roadsides; all occurred prior to 1977. Black bears were involved in 34 (97%) of the roadside injuries, while the species of bear could not be determined for 1 (3%) of the injuries. No grizzly bear-caused human injuries along roadsides were reported. Roadside injuries occurred during June (11%), July (26%), August (37%), and September (26%). All roadside injuries occurred between 8:00 a.m. and 8:00 p.m.; most occurred between 11:00 a.m. and 3:00 p.m. (59%). Adult and subadult bears of unknown sex were involved in 7 (20%) and 4 (11%) of the injuries, respectively. Female bears with COY were involved in 2 (6%) injuries, a female with a yearling in 1 (3%), an adult male in 1 (3%), and a lone adult female bear in 1 (3%). The sex and age class of the bear could not be determined for 19 (54%) of the injuries.

Thirty-four of the injuries that occurred along roadsides were minor; only one roadside injury was considered severe. The severe injury involved a person bitten on the arm by a black bear that was attempting to get food from an occupied vehicle along the roadside. The person sustained a broken arm and lacerations that required more than 100 sutures. In 33 of 34 incidents that occurred along roadsides, only one person was injured. In one incident, a subadult black bear of unknown sex bit two children who approached to get their picture taken with it.

Fifteen (43%) of the people injured reported improper behavior as a cause for injury: 9 (26%) fed bears, 3 (9%) attempted to touch or pet bears, 2 (6%) attempted to have their pictures taken with bears, and 1 (3%) approached bears for a better view. The remaining 20 (57%) reported that they were either viewing (43%) or photographing (14%) bears when the injury occurred. However, the percentage of people being injured due to improper behavior may be under-reported because of the repercussions involved

An annual average of 48 people were injured by bears between 1930 and 1970, most along park roads. The prohibition of roadside feeding of black bears has almost completely eliminated roadside bear-caused human injuries since the 1970s, and has greatly reduced the mortality of black bears as well.

with improper behavior (i.e. fear of citations, fines, or embarrassment). Of the people injured along roadsides, 22 (63%) were male and 12 (34%) were female; 1 (3%) of the reports did not list the gender of the injured person.

Injuries in the Backcountry

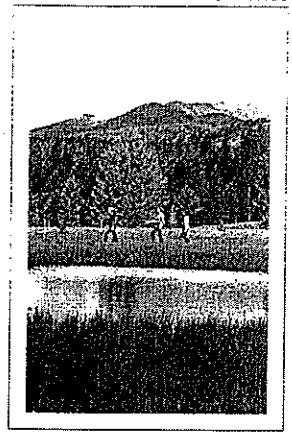
Backcountry injuries have ranged from zero to four per year from 1970 through 1994. The annual number of injuries in the backcountry has remained relatively constant despite a steady increase in the number of visitors to YNP. A total of 34 people were injured by bears in 31 separate incidents in the backcountry. In each of 3 incidents, 2 people were injured; all 3 of these incidents involved female bears with COY (2 by grizzly bears, 1 by a black bear).

Grizzly bears and black bears were involved in 26 (76%) and 4 (12%) of the injuries, respectively. The species of bear involved could not be determined for 4 (12%) of the injuries. Backcountry injuries occurred during May (6%), June (29%), July (18%), August (29%), September (12%), October (3%), and November (3%). Backcountry injuries occurred throughout the day and night. Most injuries occurred from June through September (88%) and between 10:00 a.m. and 7:00 p.m. (91%).

Most (68%) backcountry injuries involved female bears with cubs (50%) or yearlings (18%). These percentages may be underestimated because young often run off as the sow charges and thus may not be seen. Eighteen (53%) of the bear-caused injuries that occurred in the backcountry were minor, 13 (38%) were considered severe and 3 (9%) resulted in fatalities. Two of the three fatalities occurred in backcountry campsites. Of the 34 people injured by bears in the backcountry, 25 (74%) were men and 9 (26%) were women.

Thirty-one people were injured while hiking (24 by grizzly bear, 3 by black bear, and 4 by unknown species): 16 (52%) were hiking off trail and 15 (48%) were hiking on trail. Thirty of these 31 incidents involved surprise encounters with bears, while 1 is believed to have been caused by a photographer approaching a grizzly bear. The photographer was killed and partially consumed by the bear. Two of the people injured while hiking off-trail surprised bears on carcasses.

NPS Photos



Hiking parties of three or more were less likely to be attacked by a bear, probably because they make more noise as they travel.

Only three backcountry injuries (2 by grizzly bear, 1 by black bear) involved people who were camping. Two of these three incidents resulted in fatalities. Both fatalities in backcountry campsites involved grizzly bears and occurred at night.

Another important factor involved in backcountry injuries is the number of people travelling in the party. The average number of people hiking into the backcountry of YNP with an overnight permit was 3.2 people per party for the period 1987-1992; stock parties averaged 4.6 persons per party. The average size of parties with at least one person being injured by bears was 1.8 people per party. Fourteen (45%) of the injuries involved a party size of 2 people and 13 (42%) of the injured people hiked alone. Only 3 (9%) of the people injured by bears in backcountry areas reported hiking with 3 or more people.

Of the 31 people injured while hiking, only 4 (13%) reported that they were making an effort to make noise as they hiked. Of these, one was hiking near a waterfall, which may have muffled the noise she was making, and one was wearing only a small jingle bell, the noise from which probably did not carry far.

Initial Reaction of Hikers to Encounters With Bears

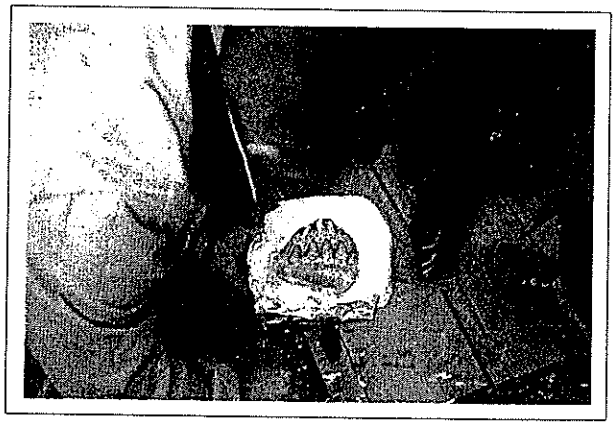
The reaction that hikers had to bears when first encountered also may have influenced the outcome of bear-human interactions. Running to or attempting to climb a tree during an encounter with a bear preceded 15 (48%) of the injuries incurred while hiking. Attempting to run away from a bear after an encounter preceded 4 (13%) and yelling at a bear during an encounter preceded 4 (13%). Three (10%) of the injured people "stood their ground" or had no time to react when charged. In one (3%) incident a hiker sprayed a charging bear with bear spray before the bear made contact. The hiker received only a minor injury. However, the injury did occur after the bear was sprayed. Only one (3%) of the injured people reported that "playing dead" was their initial reaction to a surprise encounter with a bear. In one (3%) incident, the hiker dropped to the ground when charged, but then kicked at the charging bear and was bitten on the foot. The initial reaction of the people injured was not recorded for 2 (6%) separate attacks.

Grizzly bear claws up close: notice that one claw has been broken.

Reaction of Hikers After Initial Attack by Bears

Eleven of the 31 (36%) people injured in the backcountry reported that they played dead after being attacked by a bear. Of these, 9 (82%) stated that the bear left them alone as soon as they stopped resisting, and 7 of these 9 received only minor injuries. Bears continued to attack (for an unknown time period) 2 of the 11 people that played dead after the initial attack. Both were severely injured.

Five (16%) people reported that they



Left: casting a track from a black bear's foot. Black bears are too often thought of as harmless, but hundreds of people have been injured by Yellowstone black bears, some quite seriously.

A 1930s scene at Yellowstone Lake: black bear cubs on a picnic table.

continued to resist (usually by kicking, punching, or fending off an attacking bear) after initially being attacked, and 4 of the 5 received severe injuries. In 3 (10%) incidents, bears that had injured people were chased off by a second person. In one of those 3 incidents, the bear then attacked the second person. In 3 (10%) incidents, people reported that the attacking bear terminated the attack on its own and left. In 2 (6%) incidents, people were able to climb trees to escape from the attacking bear after being injured, and in 1 (3%) incident a person continued running from a bear after being injured and the bear terminated the attack. In 1 (3%) incident, a person that had been injured by a grizzly bear sprayed the bear with capsaicin spray. The spray also got into the hiker's eyes and the reaction of the bear was not observed. However, the bear terminated the attack some time after being sprayed. For 5 reports, the reaction of the people after the initial attack started was not known or reported.

Habitats Types Associated With Injuries

Of the backcountry injuries, 21 of 31 (68%) incidents occurred in forested areas and 10 (32%) occurred in non-forested areas. Cover classes in which injuries occurred were not proportional to habitat availability. Injuries occurred more frequently in non-forested areas and less frequently in forested areas than would be expected based on the availability of the respective cover classes.

Elevation and Season Associated With Injuries

Elevations at which injuries occurred ranged from 1,711 to 2,892 m (5,614 to 9,488 ft.). The majority (74%) of injuries occurred between 2,300 and 2,600 m (7,595 and 8,530 ft.). Bear-inflicted human injuries occurred during the spring, summer and fall. Neither elevation class nor season was significantly correlated with injuries.

Bear Handling Accidents

Since 1970, two injuries to humans occurred during research (1) or management (1) handling of bears. In 1981, a researcher received minor lacerations when an immobilized grizzly bear awoke unusually quickly from the effects of a tranquilizer during a research trapping operation. In 1983, a park ranger was attempting to move an unconscious black bear (it had been hit by a car) off the road. The bear woke up and bit the ranger on the leg. The ranger received small pinch-marks that did not penetrate the skin.

Some Conclusions

Prior to 1970, most bear management involved food-conditioned bears that were extensively influenced by the availability of human foods and garbage in developed areas and along roadsides. Management after 1970 involved bears that were largely uninfluenced by human food and garbage. From 1970 through 1978, bear-inflicted human injuries decreased significantly from previous levels to an average of 6 per year. Of these injuries, an average of 4 per year occurred along roadsides, 2 per year in backcountry areas, and 1 per year in developments.

By 1979, most bears with prior knowledge of sources of human foods were no longer in the population. At this time management emphasis changed from correction of a problem (sanitation) to awareness that a high level of preventive management must become a routine part of park operations. From 1979 through 1994, bear-inflicted human injuries declined further from previous levels to an average of 2 per year. During this period, bear inflicted human injuries along roadsides and in developed areas became rare, while injuries in backcountry areas remained at about the same level as during the 1970-1978 period.

In addition, injuries inflicted by black bears have been reduced significantly from 45 per year prior to 1970, to 2 per year from 1970 through 1994, and less than 1 per year from 1979 through 1994. During the same time period, human injuries inflicted by grizzly bears have been reduced slightly from an average of 2 per year from 1931-1969 to an average of 1 per year from 1970-1994.

The large reduction in injuries along roadsides and in developed areas following the significant reduction in the availability of human foods from these areas supports the theory that the high incidence of bear-inflicted human injuries occurring in the park prior to 1970 was due to the combination of food-conditioned bears and the availability of human foods and garbage in developed areas and along roadsides.

Bear Inflicted Human Injuries in Backcountry Areas

During the period 1979-1994, most bear-inflicted human injuries occurred in backcountry areas. Most backcountry injuries involved surprise encounters between hikers, hiking in small groups (less than 3 people) and female grizzly bears with young. Most of the people injured reacted to surprise encounters with bears by running, attempting to climb trees, or resisting an attack. More than half of the people injured by bears were hiking off-trail. The chance of being injured by a bear while hiking can be reduced by taking steps to avoid surprise encounters, hiking in groups of at least 3 people, and staying on maintained hiking trails. In most, but not all cases, running, attempting to climb a tree, or resisting an attack do not appear to be good alternatives during an encounter with a bear.

Although people who were hiking were injured more often than people in backcountry campsites, injuries to people in backcountry campsites tended to be more severe. All 3 injuries that occurred in backcountry campsites occurred at night and 2 of the 3 injuries resulted in fatalities. In both fatalities the people were partially consumed. This suggests that being aggressive and resisting attacks may be the most appropriate response to attacks that occur at night in backcountry campsites. When backcountry camping, keeping all food secured from bears appears to be very important. In 2 of 3 injuries in backcountry campsites, bears had gotten into food left unsecured by the injured person. In the third incident, the bear obtained the person's camp food even though it was apparently hung properly. It is not known whether the bear got into the food before or after attacking the backcountry camper.

Bears and Menstruating Women

On the evening of August 13, 1967, two women were attacked and killed by grizzly bears in separate incidents in Glacier National Park (GNP). Following these incidents, there was speculation that due to odors associated with menstruation, women may be more prone to attack by bears than are men. Many safety

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brochures warn women against hiking or camping in bear country during their menstrual periods.

A recent study designed to test the hypothesis that bears are attracted to the odors of menstruation reported that when presented with a series of different odors (including seal scents, other food scents, nonmenstrual human blood, and used tampons), 4 captive polar bears elicited a strong behavioral response only to seal scents and menstrual odors (used tampons). This study also reported that free-ranging polar bears detected and consumed food scent samples and used tampons, but ignored nonmenstrual human blood and unused tampons. This suggests that polar bears may be attracted to odors associated with menstrual blood.

Another study analyzed the circumstances of hundreds of grizzly bear attacks on humans, including the attacks on the 2 women in GNP, and concluded that there was no evidence linking menstruation to any of the attacks. The responses of grizzly bears to menstrual odors has not been studied experimentally.

A third study recorded the responses of 26 free-ranging black bears to used tampons from 26 women and the responses of 20 free-ranging black bears to 4 menstruating women at different days of their flow. Menstrual odors were essentially ignored by black bears of all sex and age classes. In an extensive review of black bear attacks across North America, no instances of black bears attacking or being attracted to menstruating women were found.

Most injuries occurring in Yellowstone National Park prior to 1980 involved food-conditioned bears and human foods or garbage as attractants and were therefore probably unrelated to menstruation. After 1979, human food attractants had been largely eliminated and probably were not a factor in most bear-inflicted injuries. More than 38 million people visited Yellowstone during the 15-year period from 1980 through 1994. These visitors spent more than 8 million nights camping in developed area campgrounds and more than 600,000 nights camping in backcountry areas in the park. Although actual statistics are unavailable, many menstruating women undoubtedly hike and/or camp in the park each year. During the period 1980 through 1994, 21 people were injured by bears in the park. Of these 21 injuries, 15 (71%) were men, and 6 (29%) were women. Most (86%) of these injuries involved sudden, close encounters between bears and hikers and were therefore most likely unrelated to menstruation. Of the 3 (14%) incidents where people were injured while camping, 2 of the injured people were male and 1 was female. The woman was not menstruating at the time of the attack. There was no evidence linking menstruation to any of these 21 bear attacks.

The question of whether menstruating women attract bears has not been completely answered. There is no evidence that grizzly or black bears are attracted to menstrual odors more than any other odor and there is no statistical evidence that known grizzly or black bear attacks have been related to menstruation. It is extremely difficult to accurately compare the ratio of males to females that are injured by bears in Yellowstone because the park does not keep records of visitor use by gender. However, the injury data for Yellowstone National Park does not suggest that females are more likely to be attacked by bears than are males.

The use of internal tampons instead of external pads, as well as the careful treatment of used tampons in the same manner as garbage or other potential bear attractants, is most probably sufficient to reduce any greater risk to menstruating women.

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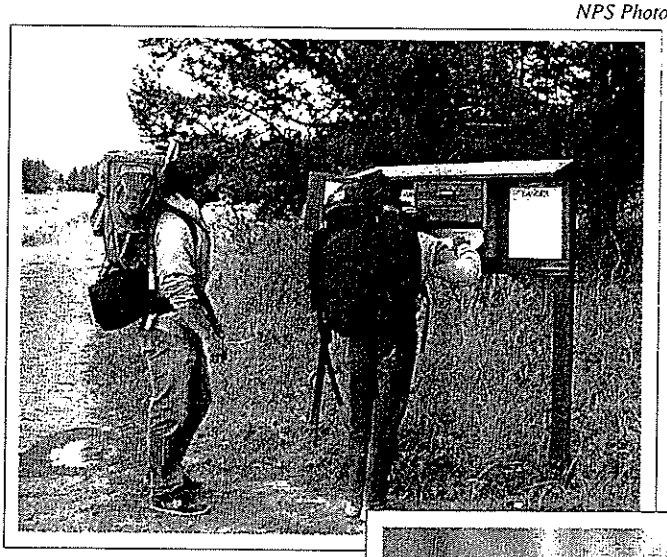


Chuck Bartlebaugh

While on the trail, a hiker's highest priority in bear safety should be to avoid surprising a bear at close quarters.

Management Implications

The data presented here indicate that roadside feeding of black bears was responsible for the high number of black bear-inflicted human injuries that occurred along park roads prior to 1977. Public education efforts and effective enforcement of regulations has virtually eliminated bear-inflicted injuries along roadsides and must remain a permanent component of future bear management programs in the park.

The data also strongly suggest that the presence of food-conditioned bears, combined with the availability of human foods in park campgrounds, led to most bear-inflicted human injuries in developed areas. Public education programs and strict enforcement of sanitation regulations have significantly reduced the number of bear-inflicted human injuries occurring in campgrounds and developed areas. Public education programs and information programs designed to prevent bears from obtaining human foods and garbage must remain a permanent bear management priority within YNP.

Despite the success of the 1970 bear management program in reducing the number of bear-inflicted injuries, an average of 1 bear-inflicted injury per year still occurs. These injuries most often involve surprise encounters between backcountry hikers and female grizzly bears with young. It will be difficult to reduce the frequency of this type of injury, especially if backcountry recreational activity and the grizzly bear population in YNP both continue to increase. Public education programs that inform hikers on how to avoid surprise encounters, and how to react to encounters and attacks once they occur, may be the most useful tool in further decreasing the number and severity of bear-inflicted human injuries occurring in the park.

Kerry Gunther is bear management specialist and Hopi Hoekstra is bear management technician for the National Park Service in Yellowstone National Park. A technical version of this paper was presented at the 10th International Conference on Bear Research and Management last summer in Fairbanks, Alaska.

Yellowstone's First Millipede

A small animal illustrates the very large world of Yellowstone research

by Rowland Shelley

One hundred and twenty-three years after it was established, the world's first national park has recorded its first representative of the arthropod class Diplopoda. The Arthropoda, the largest animal phylum, includes invertebrates with jointed appendages and exoskeletons; the five major classes are the Crustacea (shrimp, crab, lobsters, and many small freshwater and marine organisms), Insecta (insects), Arachnida (spiders, scorpions, ticks, mites, etc.), Diplopoda (millipedes), and Chilopoda (centipedes). Insecta, Arachnida, Crustacea, and Diplopoda are now known from Yellowstone (the first representative of Diplopoda is described below), although they are inconspicuous in contrast to the large, prominent vertebrates that are obvious to visitors.

This leaves the park without a centipede, and in an effort to close this void, I ransacked my reprint files searching for a published record from Yellowstone. I finally found *Nadabius vaquens* Chamberlin and Wang (1952), described from a single male collected on August 13 , 1940, at "Mt. Washburn, Yellowstone Park, Wyoming." Mt. Washburn, at 10,243 feet, one of the highest points in the park, is in the north-center of the park off the north loop road about midway between Tower-Roosevelt and Canyon Village. Yellowstone is therefore the type locality for this small centipede species, and to the best of my knowledge *N. vaquens* has not been reported or collected again. The location of this specimen is unknown, and it may be lost. It is not listed on the printout of chilopod type specimens at the National Museum of Natural History, Smithsonian Institution, Washington, D.C., the largest centipede repository in the Western Hemisphere, nor those of other major repositories including the American Museum of Natural History, New York, or the Museum of Comparative Zoology, Harvard University. If the specimen is indeed lost, a chilopodologist will eventually have to collect another male on Mt. Washburn, of course with permission of the park staff and a collecting permit, to establish the identity of this species.

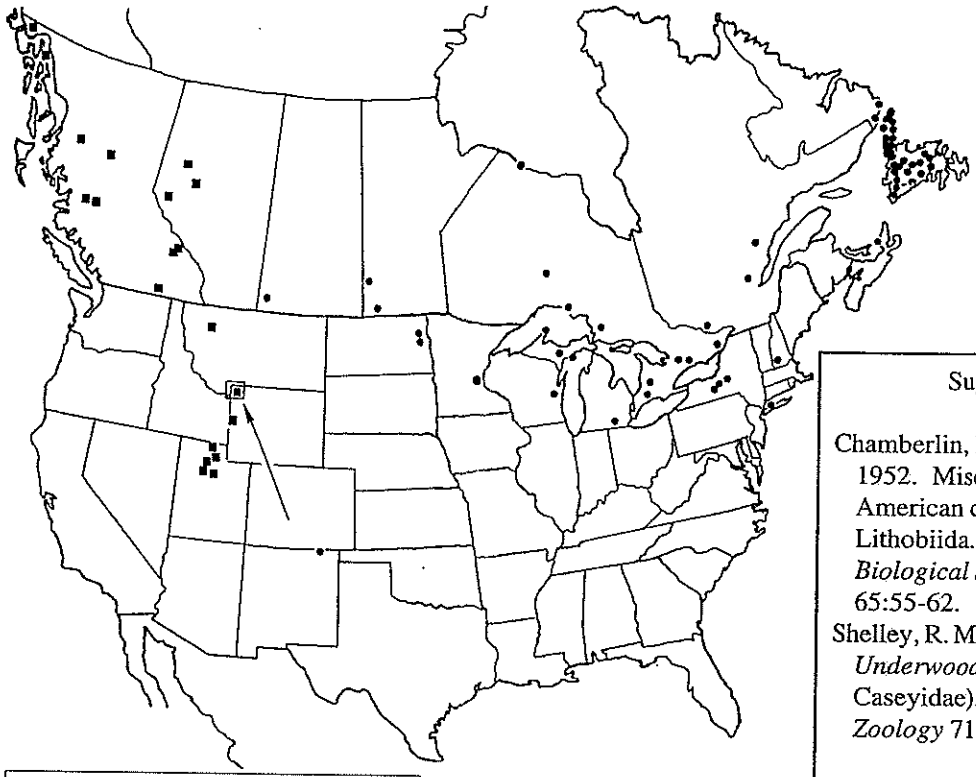
Millipedes and centipedes are closely related, as their bodies are composed of a head and numerous trunk segments; however, they differ in many features, most conspicuously the number of legs. Adult millipedes have from 34 to 750 legs (17 to 375 pairs, the high number occurring on a California species), with two pairs or four legs on most segments; adult centipedes, however, have from 30 to 382 legs (15 to 191 pairs), with one pair or 2 legs per segment. Millipedes feed primarily on decaying plant material, while centipedes are carnivores and prey on smaller organisms, particularly insects. Millipedes are harmless and defend themselves with a variety of noxious chemicals secreted by defense glands on most segments. Centipedes, however, inject poison into their prey by means of "poison claws" located beneath the head. Some centipedes in the southwestern American deserts grow to 6-8 inches and can deliver a painful bite, but *N. vaquens* and the other species that may be anticipated in and around Yellowstone are too small and weak to pierce human skin.

More research in the park in recent years has focused on the smaller organisms of Yellowstone's ecosystems, for example such insects as beetles, ants, mosquitoes, and mayflies. I now announce the discovery of *Underwoodia tida* Chamberlin (it has no common name), which was formally published in my generic revision in 1993. Almost surely, no tourist or casual visitor will ever see this cryptic millipede, and rarely will park rangers even find it; however, it is as fundamental to its niche in Yellowstone's environments as the bison and elk are to theirs. Four female specimens of *U. tida* were collected at an unknown site in the park on August 23, 1957, by Dr. H. S. Dybas and deposited in the holdings at his institution, the Field Museum of Natural History, Chicago. In contrast to the many large, colorful American millipeds, *U. tida* is small and inconspicuous, being about 1/4 inch (6-7 mm) long and a drab mottled brown in color; it has approximately 102 legs (51 pairs).

The habitat in which the Yellowstone specimens were found is not indicated on the label in the vial, but *U. tida* has been encountered elsewhere in moist leaf litter near streams, under rocks, and under fir logs in relatively dry meadows. Its distribution extends from the Rocky Mountains to the Pacific Coast in Canada and southern Alaska, the northernmost sites being in the extreme northwestern corner of British Columbia, nearly in the Yukon, and in Jasper National Park, Alberta; the species ranges southward down the Rockies into the lower 48 states, the southern limit being the Wasatch and Oquirrh Mountains near Provo, Utah.

Although a substantial millipede fauna exists along the Pacific Coast in the north-

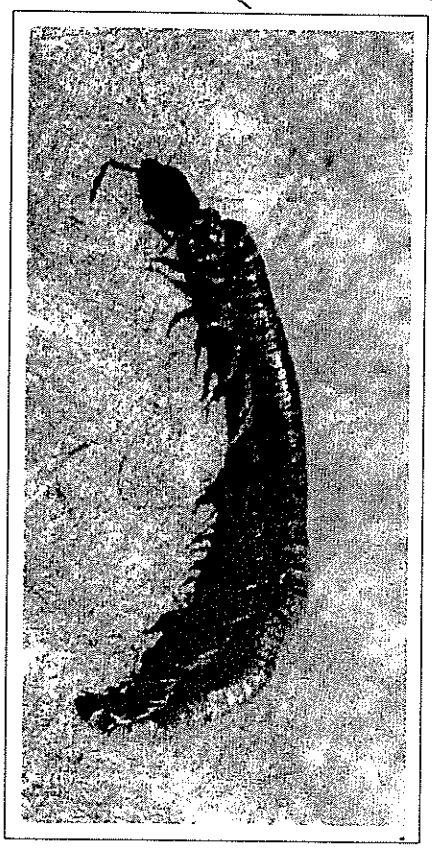
Distribution of Underwoodia *in North America. Dots,* U. iuloides*; squares,* U. tida. *The Yellowstone record is denoted by the arrow. Map courtesy of Rowland Shelley, North Carolina State Museum of Natural Sciences.*



Suggested Reading

Chamberlin, R. V., and Y. M. Wang. 1952. Miscellaneous new North American centipeds of the order Lithobiida. *Proceedings of the Biological Society of Washington* 65:55-62.

Shelley, R. M. 1993. The milliped genus *Underwoodia* (Chordeumatida: Caseyidae). *Canadian Journal of Zoology* 71:168-176.



Female specimen of Underwoodia tida. *Photo courtesy of D. J. Lyons, North Carolina State Museum Exhibits Designer.*

western United States and southwestern British Columbia, the faunal diversity increases dramatically as one moves southward into warmer climates of the United States and, ultimately, the neotropics. *Underwoodia* is therefore an exception to this rule in that it is more common in the north and one of the few truly boreal diplopod genera in North America. It occurs in a broad band across the northern United States and Canada from the Atlantic to the Pacific (see map), and it exhibits a trans-Beringian distribution pattern as it also occurs in the easternmost part of Asia. *Underwoodia iuloides* (Harger), the other North American species, extends eastward from the Rockies to the Atlantic Coast in New England and the maritime provinces of Canada. It is the most abundant native millipede in Newfoundland, and its northernmost records are from southern coastal Labrador and the south shore of Hudson Bay in northern Ontario. The southernmost locality, surprisingly, is in northeastern New Mexico, over 1,000 miles from the closest known site, in North Dakota. The third species, *U. kurtschevae* Golovatch, occurs widely in the Russian Far East, including the area around Vladivostok, Sakhalin Island, the Kurile Islands, and the Kamchatka Peninsula.

This discovery also reveals the diffuse nature of Yellowstone-related research. My field sampling, sponsored primarily by the National Geographic Society, has covered much of the western United States and Canada, and most of the distributions of the millipedes that can be anticipated in Yellowstone. As part of this research, I surveyed all known collections in both countries and discovered the Yellowstone specimens in the Field Museum holdings. Dr. Dybas, an entomologist, collected the millipedes incidentally 38 years ago while on a collecting trip, and they had resided undiscovered in the Chicago institution until I found them in a small vial that was buried in a large jar with dozens of vials of miscellaneous millipedes. This discovery of a new animal for Yellowstone was made not in the park, but in a building hundreds of miles away.

Rowland Shelley is the curator of invertebrates at the North Carolina State Museum of Natural Sciences in Raleigh, North Carolina.

Yellowstone Science Interview:
Sam McNaughton

Grazing and Yellowstone

Renee Evanoff

For the past several years, Dr. Samuel J. McNaughton, a professor of botany at Syracuse University, has been leading studies of various aspects of the ecology of Yellowstone's Northern Range. Dr. McNaughton's long experience with the grazing systems of Africa's Serengeti has resulted in many important publications on ungulate-plant interactions there, making him a recognized leader in the ecology of such systems. He was interviewed by Yellowstone Science *during the park's biennial scientific conference at Mammoth Hot Springs in September 1995.*

YS: A perennial hot topic here in Yellowstone is overgrazing. You've now put in several years directing research projects on the park's Northern Range, so you've had time not only to watch this debate, but also to participate in it. A memorable part of your participation occurred in 1991, at our first scientific conference, when you were a keynote speaker.

One of the questions from the audience went something like this: "Dr. McNaughton, based on your research with large grazing systems in Yellowstone and the Serengeti and Argentina and those other places, do you consider Yellowstone's range overgrazed?"

SM: And as I recall, my answer went something like this. Based on the ecosystem standards—that is, by the standards of the processes that are going on, in terms of primary productivity of rangelands and the amount that is consumed by the elk and bison—I do not. Because, although people have said that Yellowstone is not the North American Serengeti, in terms of the level of consumption it is very similar to the Serengeti.

So you actually could say that Serengeti is Africa's Yellowstone, or, Yellowstone is North America's Serengeti. I think

they're very similar.

YS: Did you decide to do research in Yellowstone because it was similar to the Serengeti?

SM: In a way. The reason I came to Yellowstone was an idea. It was an idea that was born of ten years of research in the Serengeti. In my experience with the African grazing systems, I learned that the large native grazers, by that I mean the wild large mammals, don't trash out the system that they depend upon. Yet the history of *domestic* large mammals all over the world is that they *do* trash it out.

The fundamental problem in all rangelands is what is elsewhere called "bush encroachment," which we in the United States call "brush invasion." The best example of that in our history was in the southwest—in Arizona, New Mexico, and western Texas in the late 19th Century. Settlers introduced large numbers of livestock onto what really were pretty lush grasslands. Then the bottom fell out climatically. The herds weren't reduced by the people who managed them; they were reduced by death, but not before they had trashed out the entire Southwest. And the record is very clear: livestock grazing turned those decent desert grasslands into mesquite bushlands.

Now, here's the idea that brought me to Yellowstone. Why hadn't elk, which people purported were overpopulated in Yellowstone, and bison, which people also purported were overpopulated, trashed out the park's rangelands? Well, that is what I came here to try to find out.

YS: The very fact that someone said that Yellowstone's rangelands weren't trashed out made quite a few headlines in 1991; it's still pretty widespread "common knowledge" that Yellowstone is overgrazed.

SM: But the graduate students who have worked with me have provided plenty of evidence that these grasslands are holding their own just fine under all this grazing pressure.

YS: But have they answered your question of why the elk and bison aren't doing to Yellowstone what the cattle did to the Southwest?

SM: They have provided evidence to suggest that the difference between livestock use of land and wild ungulate use of land has to do with mobility and timing. Livestock only move when humans move them, and humans decide when and where they will move. Wild ungulates have coevolved with their range, and they follow its productivity in a much more complex way.

Here in Yellowstone, the elk follow the productivity of the grasses up the slope. Douglas Frank, who was my first graduate student to work here, described the springtime plant productivity as a "growth pulse," in which plant greenup moves uphill, with the ungulates tracking it for the best forage, all the way up to the high country, which is their summer range.

YS: Livestock don't generally get to move that freely.

SM: No, ranchers can't work like that. They have summer ranges, say on lands leased from the B.L.M. or the Forest Service, and they do move their stock up there, but two things are different. One is the level of stocking, which is much lower in wild herbivores than it is in livestock. Look how dispersed Yellowstone elk are in the summertime. The northern herd, which is packed into a relatively small low-elevation area in the park and to the north of the park in the winter, spreads out across the whole northern half of the park, and clear down to Yellowstone Lake. Their summer range is huge. On the other hand, livestock tend to be more condensed on their summer ranges, and one of the consequences of that clumping of animals is lots of bad effects: they consume too much from a given location, and they trample too much. This isn't to take a cheap shot at the livestock industry; what they are doing works for them. But their use of the range does not mimic the kind of use that the range evolved to handle best.

And the second difference is the responsiveness of the animals. These wild animals have evolved to track this productivity in a way that is beneficial to them. But we as human beings don't do that when we're herding our livestock. We know roughly when the summer forage will be good, but we don't know it as well as the elk do, and we lag behind as these wild animals track the waves of vegetation productivity and quality. The elk are on it just at the right time to take the best advantage of the volume of it, and the peak nitrogen and mineral content of it. And that is the thing that we haven't learned yet.

YS: What made you curious about Yellowstone?

SM: Well, of course I heard people talking about Yellowstone having too many elk and bison, and how the range was being trashed. But I thought about it, and said, "Now wait a minute; I don't see all this brush coming in and invading the range in the park."

YS: No, in fact Yellowstone is experiencing just the opposite—brushlands are declining, if anything.

SM: Right. But that's not how overgrazing goes. In the classic overgrazing scenarios, the brush comes in. That's the story of overgrazing everywhere. I've seen it in Australia, I've seen it in Africa, I've seen it everywhere. If you have overgrazing, what you have is brush coming in, and it knocks out the food source of the ungulates. So I wondered, why isn't that happening in Yellowstone?

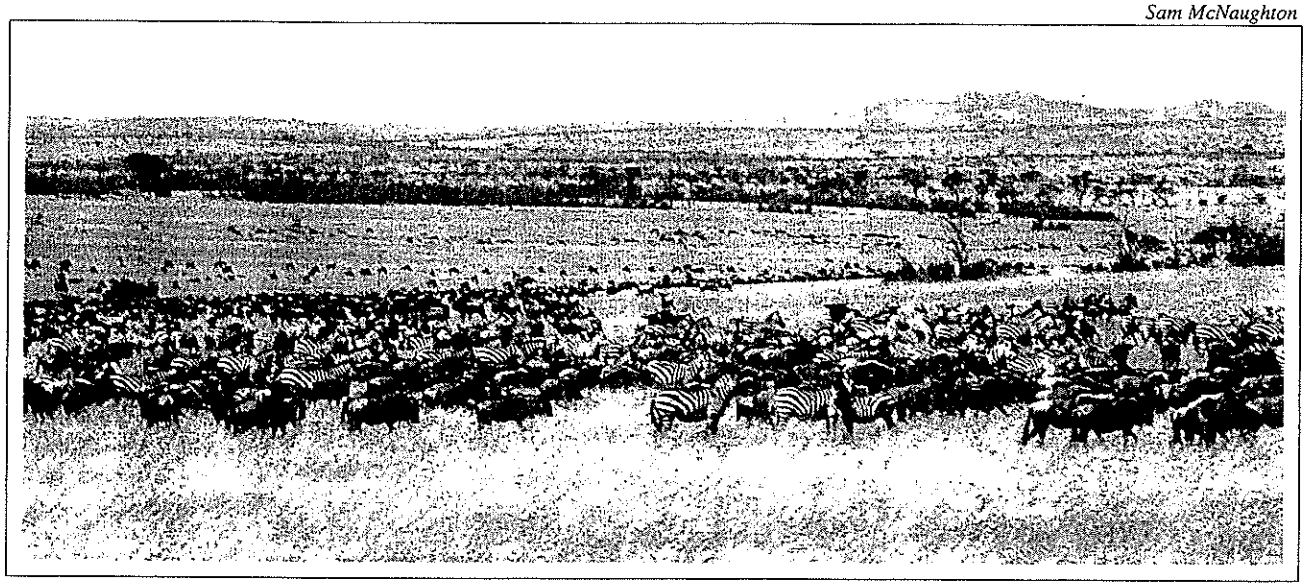
I'm a plant ecologist, but I'm also an ecosystem ecologist. To me, the point is the ecosystem. Is the system functioning, or are things breaking down? Is plant productivity deteriorating? Are we getting an invasion of unpalatable plants, or breaking down mineral processes and soils so that the rate of nutrient recycling is going to pot? That's what I'm looking at. And I don't see that in Yellowstone. Therefore, as a grazing system, this is a healthy one.

YS: But what is happening out on the Northern Range is very complex. Willow and aspen have undergone a well-advertised decline, if not in abundance at least in height.

SM: Willow and aspen are good examples of how we need to examine the context of this place if we want to understand what's going on. What are the contrasts here? What should we look at? What should we examine in order to test for that purported deterioration we hear so much about?

Many people say that the elk are damaging willows along the streams, and that they're knocking out aspens. Well, maybe, maybe not. But, just because a willow is hedged by elk browsing it doesn't necessarily mean something is wrong with the system. In fact, that willow's growth rate and rate of forage production may be higher than it would be if it *wasn't* hedged.

Sam McNaughton



Serengeti

I don't have the answer to that because I don't study willows. But I think that people who make that sort of case ought to examine it in the context of ecosystem processes.

It's just not reasonable to say that because a willow is hedged, therefore something is wrong. The grasslands are hedged, too, right? But we call that grazing. We expect it, and the studies I've been involved in here don't indicate that it's causing the grasses to be in poor health. Just the opposite: the evidence indicates that hedging keeps the grass at a growth stage that has a higher productivity and a much higher forage quality, and still stabilizes soil processes. These heavily grazed grasses in Yellowstone are producing more forage, and better forage, than they would if we knocked all the elk out of here and had grass that was waist high.

YS: Except for gardeners and the people who work in wildland range ecology, there apparently isn't much appreciation for how plants respond to "predation" by grazers, and how many factors there are that influence that process. What studies like yours show us is that plants are active players in the process, having evolved literally in the teeth of heavy grazing pressure. But what they also show us is that there are a lot of subtle factors involved in keeping the system running.

SM: When I first went to the Serengeti, I went into the Chief Park Warden's office and I said, what would you like to know from my research? And he said, well I'd like to know what the carrying capacity of the Serengeti is for big mammals. Now keep in mind that until I went to the Serengeti, I'd been a lab guy. I was grinding up plants and that sort of thing, with a white coat on. And all of a sudden I looked out the window, and thought, whoa, what am I doing in here? So I left the lab behind and got out in the real world of the Serengeti.

But even when I got there, I had this total disdain for natural history. I thought if you couldn't put a number to it, you didn't know it. But very quickly the Serengeti taught me that though there are lots of things here that I can know, I'm never going to be able to attach a number to them. But I hadn't learned that yet, and so my response to the Chief Park Warden was, no problem, I'll be back to you in a year with the answer to that question. I know it doesn't sound very intelligent, but I understood quantification, and I figured, okay, it rains a certain amount, and the soil has a certain fertility, therefore the grass would grow so much and the animals could consume so much. From that information we can simply compute the carrying capacity. This is arithmetic, right? We can just sit down in the lounge and work this out with a pencil on a napkin. No problem.

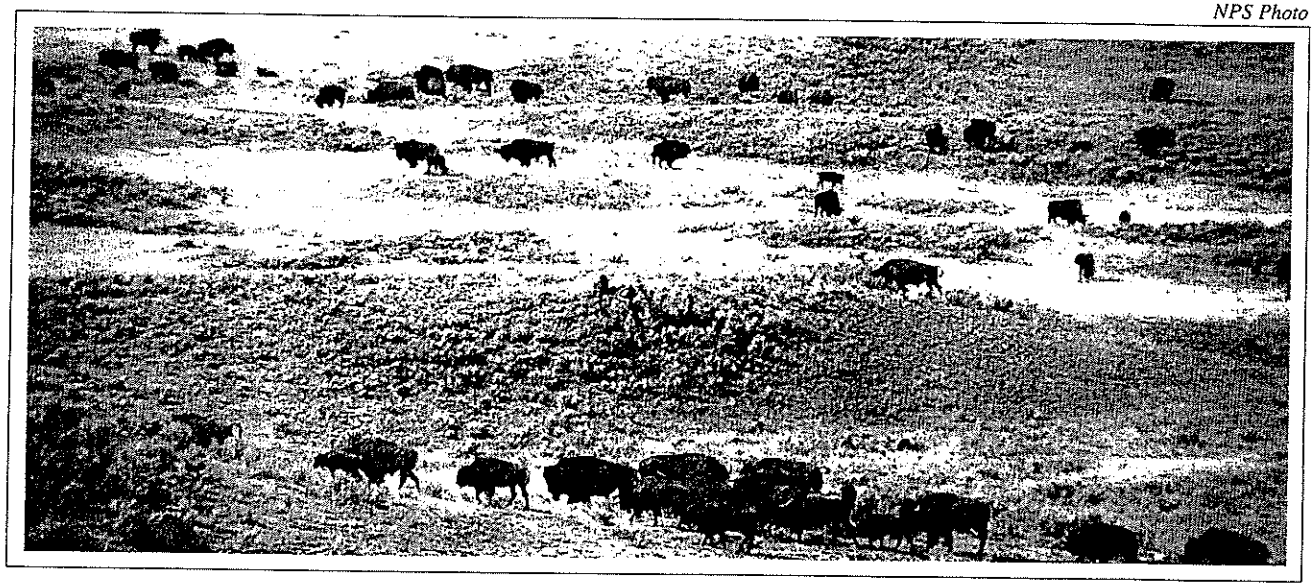
Then I did my first experiment. I put up a fence around an area that large mammals had grazed, and another couple of fences around where they hadn't grazed. My first insight: vegetation was regrowing at a tremendous rate where they'd grazed, but where they *hadn't* grazed it's all senescing out and turning into dead plant tissue and litter. Well, this sort of changes things. I mean, this is not what I'd expected it to do. So, I went to work on this, and asked what's the regrowth potential? And it turned out that the regrowth potential is pretty substantial.

What Ben Tracy, the current graduate student, has been working on here in Yellowstone, 22 years later, is nutrient recycling—that is, how the energy in the grassland system moves from the ground to the animals and back to the ground again. Here's what the mammals do. They eat forage that, if they didn't eat it, would turn into dead stuff with low nutritional quality, with a slow rate of decomposition that would cause it to accumulate in the grasslands. When they eat that forage, they turn it into nutrients that they recycle through feces and urine, and that sets the stage for regrowth. The regrowth may not happen right now; it may happen next season. And that's what's going on here. One of the things that Doug Frank showed is that the forage on the Northern Range, which is winter range, regrows much better if it's been grazed than if it's been fenced.

YS: Why is that?

SM: Well, if it's not been grazed, you get

NPS Photo



Yellowstone

all this buildup of dead stuff, right? It shades out the developing plant tissue, and no nutrients get recycled by the grazing ungulates. The result is that everything sort of stagnates. There's lots of evidence that grazing enhances plant growth, but a lot of people are unable to accept that lack of grazing in the grasslands that are adapted to grazing leads to stagnation of those grasslands. Only two things will prevent that stagnation, and get the system running again. The grassland either goes through ungulates or it goes through fire. One of the two.

YS: One way or another it's going to get its nutrients recycled?

SM: Right, and I think that I'd rather see it run through a process that turns it into biomass of ungulates.

YS: One of the interesting aspects of Doug Frank's description of what ungulates do to a range had nothing directly to do with what they eat. He pointed out that not only do ungulates run plant matter through their system, or recycle it, as you put it, but also they actively affect the whole plant environment. The example he used was that elk, simply by walking around on the soil, "tiller" the surface with their hooves.

SM: That's right. The problem is that everybody tends to think that grazing operates like a lawnmower; it just cuts the tops off the plants and has no other effects. But that's not how it works at all. The animals are doing all sorts of stuff out there. They're walking, they're laying down, they're urinating, they're defecating, and everything.

YS: Their actions are rearranging the whole top layer of soil and life.

SM: Right. It's not like these animals are just out there chomping down plant material and sending it to Philadelphia. They're eating it and then recycling it, every day, all the time they're on the range.

YS: Our friends in commercial range management come to Yellowstone now and then, look over the Northern Range, and very confidently announce that "This range shouldn't look like this." Then they point at some intensely managed commercial range somewhere else as the ideal to which we are not measuring up. When you ask them how they know what it should look like, they refer you to their professional standards, which are based on a long experience with the best way to get the most livestock growth from the land. They can tell you in inches or centimeters how tall the various grasses should be. These are bright people, too; no one can say they haven't worked hard to get their standards. They just can't see why Yellowstone should be different.

SM: You know, "should" is a very dangerous word in resource management. If you say it should look a certain way, you're implying that you have a basis of comparison with some presumably right appearance for the Northern Range. In order for me to know if their "should" is somehow the right one for Yellowstone, I have to know the context in which they define it.

I'm really a processes person. An ecosystem has both a state and a process. State is what you see out there on the ground at any given time. Process is what happens as the ecosystem changes from one state to another. If somebody tells me that it "should" look a certain way, then they are going to have to explain to me what the processes are that lead it to that state, and why the processes must lead it to that state instead of to some other state. Otherwise, I have no basis to evaluate their judgment on.

YS: So far, much of the conversation between Yellowstone's range ecologists and managers on the one hand and commercial range ecologists and managers on the other has been pretty dysfunctional. Yellowstone people object to having commercial range standards dictated to the park because they don't think that a wildland range, with a full assortment of wild ungulates, necessarily will look anything like a carefully managed commercial range that feeds only livestock. That isn't to say there's something inherently wrong with either approach; only that they are very different in what they want to achieve. Yellowstone researchers say that native ungulates don't follow the same rules as livestock, and don't treat their range the same as livestock do. But we've actually had commercial range

people respond to that by saying, well that may be true, but the Northern Range still shouldn't look like it does. It's as if the two groups talk such different languages that they can't even communicate any more.

SM: This is like someone looking at the painting "Starry Night," and saying, hold on, starry nights don't look like that to me! So, what's happening here? Unless the people who have a particular definition of "should" can tell me how they got to that definition, that the state they prefer is the correct state for the range, I can't deal with it. If they can tell me the processes that lead to their "should," and why I must believe that it's the right "should," then we're going somewhere. Then I can say, okay, maybe Van Gogh had some vision problems or something. Otherwise, I can't help them.

YS: Another engaging dialogue over Yellowstone's grazing system revolves around the question of whether or not it's like the Serengeti. Those who say it isn't emphasize the far greater number of grazing species on the Serengeti. Can you explain that disagreement?

SM: The Serengeti is tropical 1,500-meter elevation system, in an area that there weren't all the Pleistocene extinctions that affected North America. Sure there are more species in the Serengeti, and those species obviously do different things. Yellowstone doesn't have that diversity of grazers. There are no giraffes here in North America, and no elephants. Maybe it'd be good if you had some elephants knocking down some trees once in awhile, but you don't; the North American mammoths are gone. But process-wise, in terms of the productivity of this system—a mountain plateau, in the north temperate zone, with a severe climate and high levels of consumption by herbivores—it is exactly the same. Compared to the Serengeti, it may have lower productivity and lower consumption, but it is fundamentally on the same trendline as all the African data that we have.

Now, people say there's no predators in Yellowstone like in the Serengeti, but there are lots of predators. You just have to go down to Gardiner during hunting season: there are elk predators and there are bison predators right outside the borders of the park. Now, we've got the wolf back, and something is going to happen. We don't know what, but it's going to be something important. Either wolves are not going to have an impact, which is interesting, or they are going to have an impact, which is also interesting. So this is a grand experiment. I mean I can't think of another experiment like this in a national park, where a major predator has been reintroduced. Can you?

NPS Photos

YS: No, not like this. It's the first time a large predator has been returned to a western park.

SM: Look at the world as a whole. I can't think of anyplace in the world where anybody has ever done this, where they've taken a big predator, and said we're going to put this back in and see what happens.

YS: Do you care to speculate on how it will go?

SM: Well, I think they're going to kill a lot of elk and bison, but I don't think those animals are predator limited. I think you'll still have a lot of elk and bison.

YS: But there are already a lot of predators here. The coyotes and grizzly bears kill a third of the new elk calves every year. Grizzly bears, black bears, mountain lions, and coyotes all prey on the ungulates. Some of us wonder if there's already so much "background noise" in the predator-prey system, with all these predators and all these prey species, that it will be very difficult to sort out what difference the wolves really make in the ungulate populations.

SM: I think that's right.

YS: In fact, the environmental variables facing any life form in a place like Yellowstone—a large, relatively wild area—are so complex that, as you suggest, even predation might sometimes be only a minor factor. If Yellowstone ever returns to what used to be thought of as normal winters, the ungulate numbers are going to drop considerably, and it's predictable that the wolves are going to get the blame.

SM: You've already seen that. After the fires of 1988, when something like 40 percent of the northern elk herd died either from hunting or from winterkill, people tended to blame the fires, but the fires had less to do with it than the return of a real winter. Ungulates count heavily on good grazing in order to build up their reserves. If they don't get that good grazing, they're in trouble, and a lot will die in the lean season that follows.

YS: That has always been controversial in national parks; people like the idea of a wilderness reserve, but they don't want it to be quite so wild that nature takes a significant toll in dead animals.

SM: I don't think there's anything wrong with animals starving. It's part of the way the system works. Some people don't like to see it, but that's the way nature is.

YS: It's also nature's way of responding to the elk "overpopulation problem" we hear so much about.

SM: Maybe what the parks should do about this whole controversy about there being too many animals is ask the people. Well, it's their park, right? It's one of our society's best ideas, a real work of genius. Maybe we should let the people vote. Tell them what the options are, and what the consequences of those options are as well as we know them. Then hand them a questionnaire at the entrance stations and ask them: do you want to see more elk, or more wolves? Do you want your biomass in willow and aspen, or in elk and bison?

YS: Is that what it comes down to? Are the choices really that simple?

SM: Not really. I was speaking rhetorically, to suggest what the basic elements of the system are. I don't think we have to choose absolutely between the ungulates and the vegetation. The system will make those choices for us if we let it. It looks to me as if the vegetation *and* the ungulates are doing pretty well out there.

YS: Sometimes Yellowstone is presented to its constituents as if its problems are unique. What about these other big grazing systems like the Serengeti; do they have this debate?

SM: Oh, absolutely! Everyplace I've been, there are two diametrically opposed

views about national parks or other reserves. One view says let the system operate as independently as possible, and the other view calls for total intervention. The South Africans have done very well at intervention. They have parks bigger than Yellowstone, bigger than Serengeti, totally fenced. Nothing can get in, nothing can get out, and they have quotas for everything: how many kudu there should be, how many wildebeest there should be, you name it.

YS: There's that word "should" again.

SM: Right. Only their control is so absolute that they often can make it work the way they want it to.

YS: How did *they* decide what was right?

SM: I have a theory about that. I think everybody tends to want their reserve to be the way it was when they first saw it.

YS: That certainly was the prevailing standard for most parks in the United States for a long time. It was assumed that we should preserve them in the form they were when white people first saw them.

SM: But historical standards don't work either. You can track down the first photographs of Yellowstone, from 1871, and study them, and say, okay, here's what the photos show us about vegetation and wildlife, so it's our job to make it that way. We have to arrest things in that state. But not only is that against the laws of nature, it doesn't make any sense. The world isn't like it was in 1871. The climate is not the same. Everything has changed.

Let me tell you about Kruger National Park in South Africa, the best-managed national park in the world, or at least the most intensively managed. Some years ago, the wildebeest population got too high, at least according to the management targets, as they call them, and so they started killing wildebeest. Eventually, they got the wildebeest back down to the defined target, so they stopped shooting them. But the wildebeest numbers kept declining, and got below the lower end of the acceptable numbers as defined by the management target. So to correct for it, they decided they'd better go out and shoot some lions, so that predation on the wildebeest would ease off. But even after that, the wildebeest continued to decline. Well, eventually what they discovered was that the wildebeest population is anticyclic with the wet and dry periods. During dry periods, the wildebeest increase, and during wet periods, they decrease. The wildebeest had their own targets, and we just didn't understand them. It had little to do with the lions. And that's the thing; there are always hidden things in nature.

The point is that we have to be really confident that we understand what's going on before we start interfering. If we make the decision that the range is degraded in northern Yellowstone, we'd better be very clear about what the new targets are. I don't see clear alternatives emerging from these viewpoints that say there are too many elk. I mean, I see a lot of hand grenades coming across the transoms of the park's managers, but there's nothing especially constructive there in terms of justifying another approach.

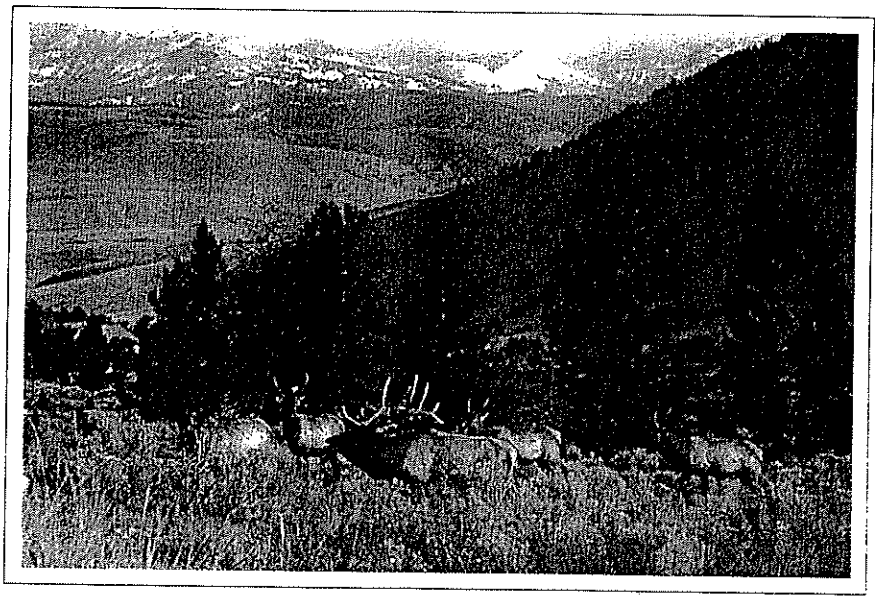
YS: Some say that Yellowstone's whole history can be seen as a big, kind of undirected experiment, where we have to do a great many things wrong to learn the right way to do it. We suppressed fire, we killed predators, we stocked exotic fish, we slaughtered thousands of elk, pronghorn, and bison, or we fed those same animals, and each time we eventually learned that in some way our actions were a mistake. Other people think we now know enough to decide to take such aggressive actions all over again, and insist that we do. Looking back on all this unintentional experimentation, and what it's brought us, and considering what your studies have shown, do you think we as a society are getting better at this? Will we ever really figure out what we "should" do in national parks?

SM: Hold on! Don't forget that you're talking to a professor here. Do you know what professors do? We profess! I have to believe that we're getting better!

YS: Well then, assuming that we are learning, what could we do to make the process by which we decide what to do next less painful?

SM: It would make a big difference if we could take the rhetoric out of it. That's the problem. It's those people who say, "This is what it should be," but without a sufficient basis to justify it. There's the problem, and this is what education fights. "This is what it should be." "But why?" "Well, because I say so."

The real challenge that park managers face is that the problems involved with the elk, however anyone defines those problems, have to be faced now, even though your information may be incomplete. I don't have to face that; I just profess. Your critics don't have to face that; they have the luxury of standing back and pointing out what you "should" do with no real risks to themselves. Like my experience on the Serengeti, there were a whole lot of things I knew about, but I didn't know well enough to put numbers on them. Whether you have numbers or not, you have to decide what to do.



Wolf Restoration to Continue if Budget Negotiations Allow

As of mid-December, plans were underway to continue wolf restoration in both Yellowstone and central Idaho this winter. Because of cuts in federal funding, a combination of private and federal funding will support the capture and transport of wolves from Canada to both areas, following procedures developed and successfully tested last winter. As of early January, though the second furlough of federal employees had ended, it was not clear if funding would be provided to the U.S. Fish and Wildlife Service for this project.

This year, efforts to capture and radio collar Canadian wolves will be focused in northeastern British Columbia (last year's wolves were brought from Alberta). Then, in January, Canadian and U.S. Fish and Wildlife Service biologists will capture wolves from the packs previously located in December, radiocollar them, and relocate the collared wolves (approximately 30 of them, from several different packs) following the same release procedures as last winter. The wolves released in Idaho will again be "hard-released" (without a period of acclimation in a pen), and the Yellowstone wolves will spend up to ten weeks in acclimation pens prior to release.

In late summer and early autumn, park staff again prepared the acclimation pens. Two of last year's pens, at Rose Creek and Crystal Creek, were repaired and left in place, while the Soda Butte pen was moved to the Blacktail Plateau, and a fourth pen was constructed near Nez Perce Creek, a tributary of the Firehole River in central Yellowstone. Biologists are concerned about placing new wolf groups in areas already occupied by last year's wolves, who generally established home ranges near their acclimation pens. That consideration, and considerations relating to the group structures of the new wolves, will influence which pens, as well as how many pens, will be used this winter.

Wolf project biologists and their advisors consider last year's restoration efforts to have been very successful and instructive, and so this year's introductions will follow the same plan. Biologists will visit the pens approximately twice a week to provide road-killed ungulates as food and to check on the animals and their pens. Otherwise, observations will be extremely limited, and the areas immediately around the pens will once again be closed to visitor activity. The wolves will be released in late March or early April, prior to any denning activity by breeding pairs. Wolves in the Nez Perce Creek and Blacktail Plateau pens would be released on site; both areas were historically known to be occupied by wolves, and the Firehole Valley, like the Northern Range, supports resident herds of elk and bison.

Montana Man Convicted of Killing Wolf #10

On October 25, 1995, a jury deliberated less than two hours to find Chad McKittrick, of Red Lodge, Montana, guilty of killing, possessing, and transporting a wolf. The wolf was #10, the male from the Rose Creek pen, whose mate, #9, gave birth to eight pups near Red Lodge shortly after his death. Biologists discovered the wolf's death after his radio collar transmitted a mortality signal. The collar was later found near a public road, and an informant told the U.S. Fish and Wildlife Service of the carcass's whereabouts and of McKittrick's actions. Investigators then searched McKittrick's residence, finding the skull and hide of #10.

McKittrick could be sentenced to as much as six months in prison and fined up to $25,000 for his actions, which violated the Endangered Species Act. Maximum penalty for the transportation count, a high misdemeanor, is a year in prison and a $100,000 fine. As of mid-December, McKittrick had not been sentenced.

Soda Butte Wolves Kill Hunting Dog, Anger Ranchers

On Friday, December 8, the U.S. Fish and Wildlife Service received a call that a pet lion dog (a Walker hound) had been killed by wolves on private land 15 miles southeast of Nye, Montana. On the previous Wednesday, December 6, the Soda Butte pack (five adults and one pup) were located by airplane in the Absaroka-Beartooth Wilderness, in the Stillwater drainage, Custer National Forest, but a Friday flight was unable to locate them in that area. The dog was killed about 20 miles from the pack's last known location, in an area the pack had not visited before. A flight on Saturday, December 8, established that the wolves were in the area where the dog was killed.

Animal Damage Control (a bureau of the U.S. Department of Agriculture) investigated the incident and confirmed that wolves were responsible for the dog's death, the third known wolf-caused death of a dog since wolf recovery began in Montana in about 1982.

The wolf recovery plan calls for management actions if wolves are repeatedly involved in problems with domestic livestock or pets, but, according to Ed Bangs, U.S. Fish and Wildlife Service gray wolf recovery coordinator for Montana, "this is not a depredation situation that would require control. The wolves did not seek out a pet nor are they likely to cause repeated depredations on domestic dogs."

Ranchers, on the other hand, regarded the unannounced arrival of the wolves on private land a breach of trust, because they had been assured by federal officials that they would be notified if the wolves approached their lands. The appropriate notifications (to the U.S. Forest Service and Montana Department of Fish, Wildlife and Parks) had been made of the pack's location on December 6, but as the wolves have repeatedly demonstrated, they may move long distances in a very short time, between surveillance flights. When the December 8 flight did not locate the Soda Butte pack in its December 6 location, biologists mistakenly assumed the pack had moved back toward the park.

By late December, the Soda Butte pack had moved back toward the park. In early January, they were spending most of their time east of the park on wilderness lands.

Rose Creek Wolf Pup Killed by Vehicle

At about 7:00 p.m. on December 19, Wolf #22 was hit by a delivery vehicle near the Buffalo Ranch in Lamar Valley. The nearly eight-month-old black pup was one of eight siblings born to the Rose Creek alpha female (#9) in late April near Red Lodge, Montana. Shortly after the birth, the female and the pups were relocated back to the Rose Creek acclimation pen. Her mate (#10), was illegally killed shortly before the birth, and it was judged necessary to relocate the family away from the developed area, so that biologists could help her with the initial months of rearing the pups. The mother and pups were released from the pen on October 11, and were often sighted in the Lamar Valley and near the Buffalo Ranch.

"This is a very unfortunate incident because the loss of any animal from this tiny population is a great loss to the restoration program," Superintendent Mike Finley said. "The young male, which weighed 65 pounds at death, was in excellent condition. Number 22 would have been a great asset to the recovery process." He urged visitors to be extremely cautious while driving in the park at night.

Necropsy studies will be conducted, for the scientific and educational value in terms of genetics and parasites. No action was anticipated against the driver of the vehicle.

Wolf #3 Kills Sheep

Yellowstone-area livestock herds suffered their first losses to predation by the new wolves the second week in January. A ranch on the Dry Creek Road, southwest of Emigrant, Montana, reported a sheep killed and another injured in Monday, January 8, and another sheep was found dead on Friday, January 12. The latter sheep was the only one confirmed to have been killed by a wolf.

A wolf was not sighted in the area until Thursday, January 11, but could have been in the area for several days because the federal government shutdown and weather conditions had reduced the number of tracking flights biologists were making. On January 11, a flight confirmed that Wolf #3, a yearling male from the Crystal Creek group, was in the area. On Sunday, January 14, predator control agents of the Animal Damage Control agency, working with Yellowstone biologists, captured the wolf by netting it from a helicopter, then tranquilized it and moved it to the Rose Creek acclimation pen. Ed Bangs, U.S. Fish and Wildlife Service wolf recovery project leader, said that #3 might have been attracted to the Emigrant area by a large colony of captive wolves kept on private property in that area.

Under the rules of the reintroduction plan, a wolf killing livestock will be given a second chance; if it kills livestock again, it will be removed from the population. As of January 17, #3 was still being held. Among the options being considered for him were relocation to a remote part of the park, perhaps in the southern portion, and pairing him with a new female from this year's Canadian trapping program, which was underway at the same time. The ranchers, whose loss of sheep was finally determined to be at least two and perhaps as many as four, were assured that they would be compensated for their losses. Defenders of Wildlife maintains a fund for this purpose.

In late December and early January, biologists reported that the dispersal of young wolves from the established packs appeared to be underway. This dispersal is an anticipated event; usually at this time of year, some of the yearlings leave the pack and begin to wander more on their own. Wolf #12, a member of the Soda Butte group, has also been reported making long-distance trips, including one to public lands southeast of Yellowstone National Park.

Unlike the recent incident in which members of the Soda Butte group killed a dog near Nye, Montana, there were apparently no complaints about the quickness of agency reaction to the situation; the wolf was caught very quickly after the incident. However, Montana Governor Marc Racicot has stated his objection to the continuation of the Yellowstone wolf recovery program.

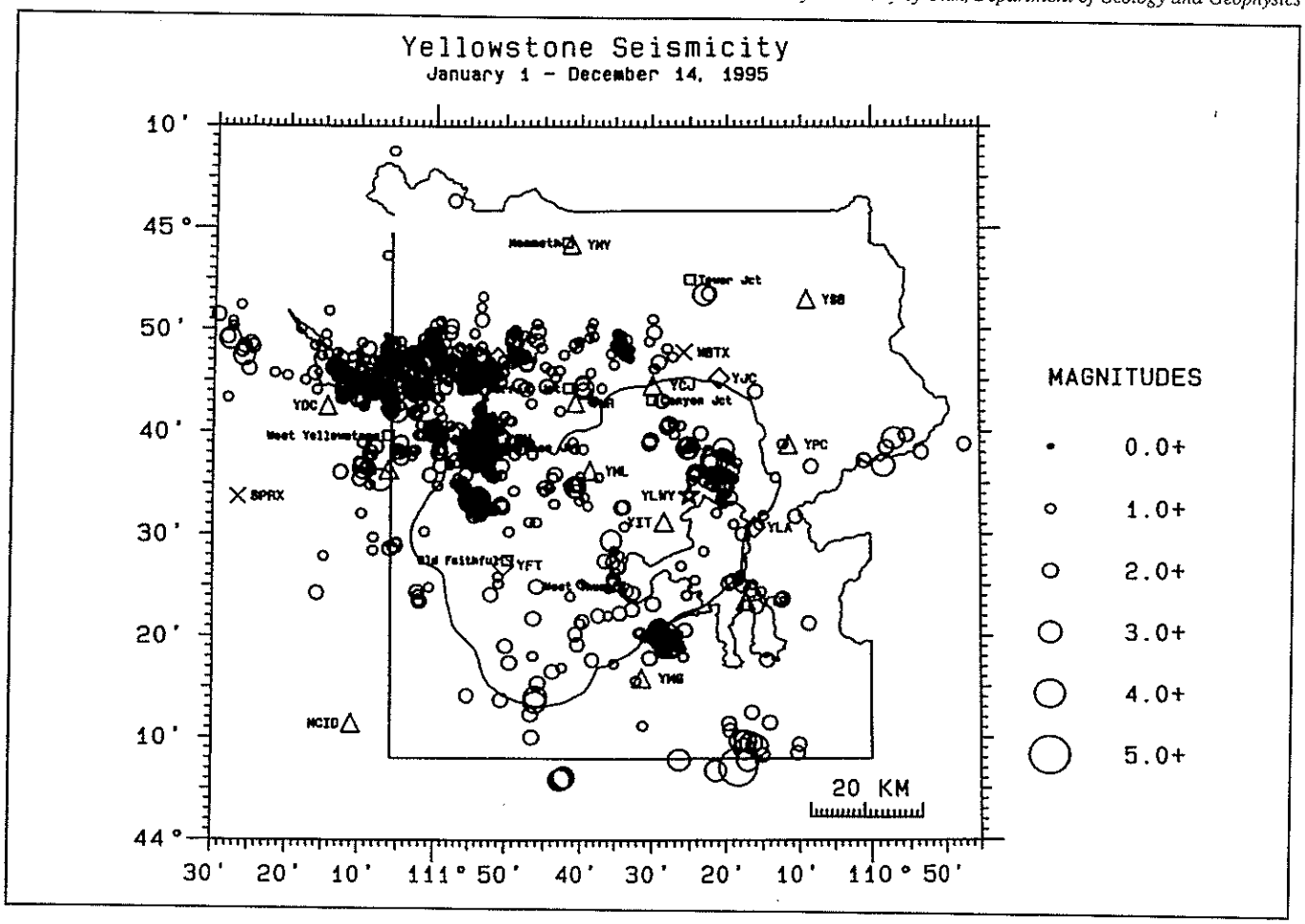
Marvin Jensen New Assistant Superintendent

On December 1, Yellowstone Superintendent Mike Finley announced the selection of Marvin O. Jensen as the new assistant superintendent. Jensen replaces Joseph Alston, who left more than a year ago to become superintendent of Glen Canyon National Recreation Area.

NPS Photo

Jensen is 55 years old, and received his B.S. in range management from Utah State University in 1963. He began his 32-year federal career with the Bureau of Land Management that year, as a range conservationist at Kanab, Utah. His first position with the National Park Service was as unit manager at Grand Canyon National Park. He has also been a management assistant at Sequoia and Kings Canyon National Parks (1981-1987), superintendent of Kenai Fjords National Park (1987), superintendent of Glacier Bay National Park and Preserve (1988-1994), and superintendent of the Mojave National Preserve (1995). Jensen and his wife, Mary Lynn, have two grown children. He began work in Yellowstone in late December.

Courtesy University of Utah, Department of Geology and Geophysics



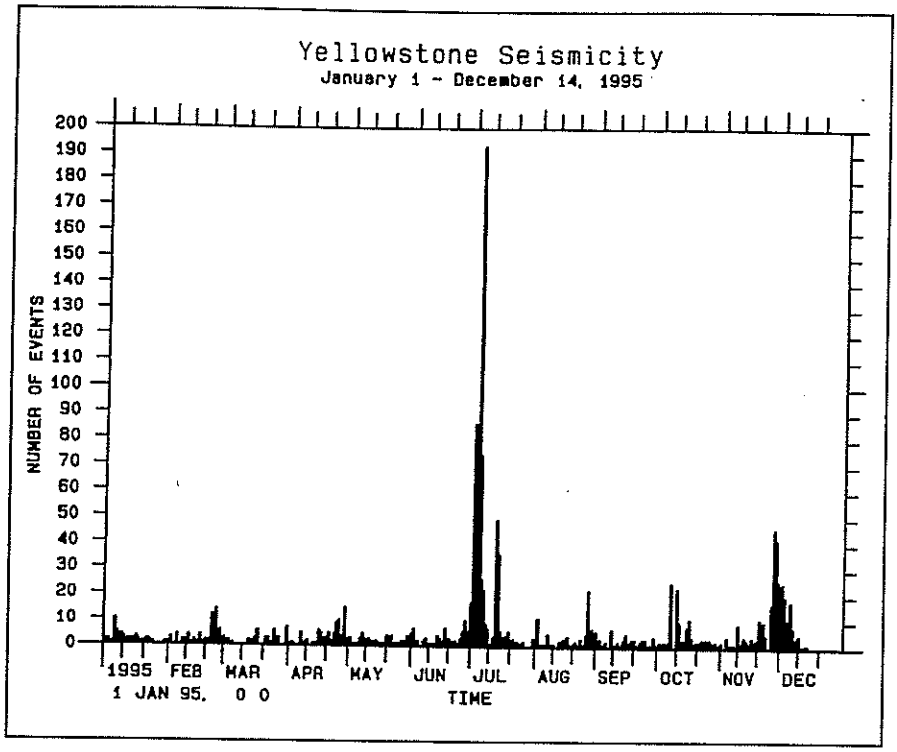
Above: Epicenter map of ~1600 earthquakes (circles) located from January 1 through December 14, 1995, in the Yellowstone National Park (YNP) region. The open triangles and diamonds represent the locations of YNP regional seismograph network stations operated by the University of Utah. Opposite: Time histogram of earthquake activity in the Yellowstone National Park region for the same time period. A swarm of several hundred earthquakes occurred in early July, just west of Madison Junction.

Earthquake Swarms Along Caldera Boundary

On July 4, 1995, Dr. Robert Smith, University of Utah researcher who has studied Yellowstone's geology for many years, alerted park that the west side of Yellowstone, near the boundary of the Yellowstone caldera, was experiencing a very intense earthquake swarm. The unusual activity began on June 30, and the earthquakes were clustered near Mount Haynes (just south of the Madison River). The swarm started out with about 700 events per day, with magnitudes up to 2.5 on the Richter Scale. Activity subsided in frequency until July 4, when it increased to about three or four events per minute. None of the earthquakes were felt, and Yellowstone Research Geologist Rick Hutchinson observed no unusual changes in geyser or hot spring activity.

This most recent swarm of earthquakes occurred only a mile or two northeast of an April-May swarm. Smith described the July swarm as in line with a 1985 swarm, and part of a persistent trend of earthquakes that occur along a line extending from the Pitchstone Plateau in southern Yellowstone, northwest past Old Faithful.

A smaller swarm with more felt earthquakes occurred starting on September 28 and continuing into early October. Smith summarized the swarm as occurring on the northeast side of Mt. Sheridan (the southeast side of the Yellowstone caldera), "very near the point where the projection of the north-trending Red Mountain fault intersects the mapped caldera boundary. U.S.G.S. [*U.S. Geological Survey*] geologists have mapped a post-caldera collapse rhyolite vent located in the epicentral area.... We do not know the source of the earthquakes, but they could be related to such plausible mechanisms as: 1) down-dip tectonic earthquakes on the eastward projection of the Red Mountain fault, 2) earthquakes occurring in response to fault motions associated witht the interaction of the caldera boundary fault with the Red Mountain fault, 3) earthquakes that may be related to a zone of weakness that may be associated with the fault and the volanic vent, 4) earthquakes associated with the Heart Lake geyser system (which is very close to the epicenters). The earthquakes could also be related to hydrothermal fluid migration and hence may have affected the temporal and volume discharges of this geyser system."



The largest earthquake in this swarm was a 4.3 on the Richter Scale; Grant Village staff reported feeling about half a dozen of the quakes. Smith said that "this year's rates of earthquake occurrence are well above the annual average." The last year in which this rate of earthquake occurrence was achieved was 1985.

Yellowstone Experiences Shutdowns

As a result of various stages of this winter's budget impasse, Yellowstone National Park was significantly affected by the two "shutdowns" of the federal government. The first shutdown, which ran from Tuesday, November 14 until the following Monday morning, had relatively little imact on park operations because the park was largely shut down anyway. The roads had been closed for the winter, and were not scheduled to reopen for winter (oversnow) traffic until December. The road across northern Yellowstone was kept open for public access to the communities of Silver Gate and Cooke City, Montana, near the Northeast Entrance. The Albright Visitor Center and the Mammoth Hot Springs Campground were closed, and the park was closed to all recreational activities.

The second closure began on December 17 and ended on January 6, and had much more severe effects on the park and its neighbors. At the beginning of the closure, visitors at the Old Faithful Snow Lodge were asked to leave, and the Mammoth Hot Springs Hotel was not permitted to open. The timing of the closure, over the winter's major holiday period, was reported to have major effects on many businesses in the park and in nearby communities. Estimates of total losses were not available in time for this report.

On January 6, all park and concessioner facilities reopened to visitor use. "Park staff are pleased to be back at work and are anxious to get back to serving the public," said Superintendent Mike Finley. "This closure has been difficult not only on our staff, but our many concessioner and community friends. However, we have found a silver lining in this dark cloud through the overwhelming support we've received from the communities, concessioners, our local and state governments, and our own federal employees. Banks have offered low interest loans to employees, and creditors have been willing to work with park employees during this time of uncertainty." In a January 6 statement about the national park system, NPS Director Roger Kennedy said that "Our jubilation at opening visitor facilities in the parks is tempered with profound regret at the damage done to our employees and our neighbors."

Though the funding measure that was approved for the parks does allow for all park facilities to remain open through September 30 (the end of the NPS fiscal year), the funding status of many parts of the parks' operations remain unsettled. Only those park operations directly related to visitor services have been approved so far. Many Yellowstone programs, including those related to resource management and research support, are apparently not covered by the funding.

Court Rules on Grizzly Bear Recovery Plan Lawsuit

On September 29, a U.S. District Court Judge ruled on a lawsuit filed concerning the 1993 *Grizzly Bear Recovery Plan* issued by the U.S. Fish and Wildlife Service. The court held in part for the plaintiffs, the Fund for Animals et al., and in part for the defendants, Secretary of the Interior Bruce Babbitt et al. The plaintiffs had argued that the plan was inadequate in a number of ways. The court held that it was not immediately necessary for the government to designate critical habitat or linkage zones for grizzly bears, and that the plan was sufficient in addressing site-specific management actions for grizzly bear recovery, such as road density standards, in the several recovery areas in the lower 48 states.

However, the court found that insufficient information was provided by the government to justify as "objective, measurable criteria" the methods outlined in the plan for monitoring populations, and to explain how the planned conservation strategy (now being produced) would demonstrate the existence of adequate regulatory mechanisms to protect bears and their habitat if the species were to be delisted from protection under the Endangered Species Act.

The court also questioned the government's decision not to list the Cabinet-Yaak grizzly bear population as endangered rather than threatened. The court gave the U.S. Fish and Wildlife Service 90 days to reconsider those portions of the recovery plan found to be insufficient.